account the impact of the potential taboos. Using computer resources provided under the auspices of the Broadcast Caucus, studies were undertaken of ATV accommodation statistics taking into account taboos under various scenarios. The first scenario applied the taboo restrictions to all ATV and NTSC assignments, the second scenario applied the taboo restrictions only to existing NTSC assignments, while the third scenario also applied the taboo restrictions to existing NTSC assignments, but allowed collocation or near collocation of the taboo channel. Four preliminary findings resulted from this on-going work: First, regardless of which scenario was examined, the adjacent channel taboo was determined to achieve the worst accommodation statistics for ATV, while the IM-related taboos exhibited the best statistics. Second, the NTSC/Co-located Scenario was determined to achieve the best accommodation statistics. Third, except for the picture image taboo, the effect of increasing or reducing taboo separation distance has little or no impact on the ATV accommodation statistics. Fourth, allowing exact collocation of the taboo channel slightly/moderately improves the accommodation statistics of ATV. Near collocation of the taboo channel adds little, if any, improvements to the accommodation statistics.

Second, there were considerable discussions within the Working Party on whether PS/WP-3 is ultimately tasked with recommending specific ATV channel assignments to existing licensees. While such data will be available, there seems to be no clear consensus on how to proceed. The Working Party will continue to address this issue during the next working period, and may seek further guidance from the Advisory Committee on this issue.

In addition, during the next reporting period, Specialist Groups 6 and 7 will complete their currently on-going studies regarding the impact of "taboos" on ATV spectrum availability. These specialist groups will also continue their efforts regarding the possible development of the computerized service area and interference model for evaluating and comparing ATV transmission systems. Following the work just described, further efforts by these two specialist groups will, by and large, have to wait on the results of the tests of the proponent ATV systems by the ATTC.

Specialist Group 10, which deals with the development of the planning factors necessary to determine the basic service areas of the new ATV service, continued its work during the reporting period. Utilizing the planning factors used in the NTSC Channel Allotment Plan as a point of departure, the specialist group began the process of identifying and modifying the factors to take into account the new information associated with ATV systems/channels. Specialist Group 10 also provided support to the Working Party in responding to a request from SS/WP-4 regarding how to judge

the spectrum related aspects of particular ATV systems. SS/WP-4 adopted PS/WP-3's criteria in this respect.

The specialist group worked with SS/WP-2 in determining how to use the ATV system's test results. First, the specialist groups recognized that a computer program allowing the rapid preparation of graphical representations of interference-free service areas under a variety of geographic spacing and power/antenna height combinations would be desirable for future studies. Zenith Electronics Corporation has developed a program for this purpose and offered its cooperation to this end. The specialist groups and the Working Party are currently exploring alternatives for acquiring and validating such a capability, and have invited the active participation of other proponents in this effort.

In the next reporting period, Specialist Group 10 anticipates acquiring information from the manufacturers of television receiving antennas regarding the technical characteristics of their products. This specialist group will also continue to consider the proper definition of coverage areas for ATV systems while paying particular attention to the special characteristics of digital transmissions systems.

Specialist Group 4, dealing with the possibility of accommodating ATV systems in the spectrum above 1 GHz, and Specialist Group 9, dealing with cross-border allotment issues, were essentially dormant this reporting period, although attention of the specialist groups was drawn to Mexico's 12 GHz propagation tests. During the next reporting period, Specialist Group 9 will reinforce its efforts to re-establish contacts and a constructive working relationship with appropriate Canadian representatives, and to establish initial contacts with appropriate Mexican officials.

II. BACKGROUND AND INTRODUCTION

This document constitutes the Fourth Interim Report of the Spectrum Utilization and Alternatives Working Party (Working Party 3) of the Planning Subcommittee of the Federal Communications Commission's Advisory Committee on Advanced Television Service. As described in more detail in its three earlier reports, Working Party 3 (PS/WP-3) was given primary responsibility of providing the Planning Subcommittee and, ultimately via the Advisory Committee, the FCC with advice

concerning spectrum utilization and alternatives as related to the Advanced Television Service (ATS). The meetings of the Working Party continued to be well attended during the reporting period. Attendance by name and affiliation is summarized in Appendices D and E, respectively.

Also, as previously reported, PS/WP-3 initially divided its work into three fundamental parts. The first part was to deal with various alternatives for accommodating an Advanced Television (ATV) system within existing VHF and/or UHF television allocations. This part of the work was subsequently expanded to include consideration of United States - Canada and United States - Mexico cross-border allotment issues. The second part of PS/WP-3's effort was to deal with the issues surrounding the alternative of accommodating ATV in the region of the spectrum above 1 GHz. The third and final part dealt with the possible impact of ATS on the spectrum utilization of various broadcast support and non-broadcast services.

Again, as previously reported, PS/WP-3 organized itself into specialist groups in order to more effectively carry out its work in each of the three areas noted above. During the current reporting period, Specialist Group 3 continued its work analyzing the impact of ATV on broadcast support services and non-broadcast spectrum, and the results of their efforts are described in Section III. The work of Specialist Group 4 relating to accommodating ATV in the spectrum above 1 GHz has, for the most part, been deferred for

reasons briefly described in Section IV. Also during the reporting period, Specialist Group 6 on Spectrum Analysis and Specialist Group 7 on Taboos continued to work in tandem since the principal effort to analyze spectrum requirements for ATV systems is now focused on the critical issues surrounding the taboos. The work of these combined specialist groups, along with the work of Specialist Group 9 dealing with cross border issues, is described in Section V. Specialist Group 10 continued its efforts to develop planning factors for eventual use in determining the basic serving area(s) for the new ATV service. In this regard, Section VI sets forth the work accomplished by Specialist Group 10 on (a) Planning Factors Development, (b) Definition of Spectrum Criteria, and (c) Criteria Evaluation. Finally, Section VII presents a description of the future work planned by PS/WP-3.

III. BROADCAST SUPPORT SPECTRUM (SPECIALIST GROUP 3)

A. Introduction

Specialist Group 3 (SG-3) has been assigned the responsibility of examining Broadcast Support spectrum. Included in that responsibility is an examination of the Broadcast Auxiliary Service (BAS) spectrum. This spectrum is used by television stations to convey their signals on a point-to-point basis. Uses include studio-to-transmitter links (STL's), intercity relays (ICR's), electronic news gathering (ENG) and a variety of other applications. Some of this spectrum is shared with non-broadcast users who will also require protection from interference.

Spectrum studies[1] have been conducted to determine the amount of congestion in the BAS bands and the possibility of accommodating ATV with existing broadcast support allocations. Two studies were conducted to determine the level of congestion in the television auxiliary frequency bands. One study of the top 50 market chief engineers detailed the level of usage in the STL, ENG, and ICR bands. The respondents considered all three bands (STL, ENG and ICR) to be congested, with the STL and ENG bands the most cluttered. It was found that requests for more frequencies in the three sets of bands are quite likely from many of the responding stations. In a companion survey of frequency coordinators, most respondents found the 2 GHz and the 7 GHz bands to be heavily used, with 2 GHz posing the biggest coordination problem. These studies have demonstrated the severity of the congestion facing users of auxiliary spectrum. A third study indicated that in markets below the top 30, additional STL channels for ATV could be accommodated within existing allocations.

New techniques in transmission and/or coordination must be found for more efficient use of the current BAS bands, or additional spectrum for broadcast auxiliary spectrum will have to be found with propagational characteristics similar to the present bands. Only by satisfying the auxiliary spectrum needs can the contributory and distributory requirements of

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[1] The NAB conducted these surveys, in coordination with Planning Subcommittee Working Party 3 in June, 1989.

the new ATV stations be satisfied, thus providing all existing television stations the opportunity of providing a terrestrial ATV broadcast service. Alternative media, such as fiber optics, may very well provide some relief for spectrum congestion.

B. Critical Issues

Simultaneous transmission of two signals, which may or not be identical and may or not be transmitted to or from the same site, could require substantially more capacity and thus could likely require additional support spectrum. Differences in spectrum requirements, if any, between contribution circuits and distribution circuits need to be identified. If the ATV encoder is located at the studio, then the STL must be only slightly better in performance than the transmitter that is fed by the STL. Other circuits (ICR, SEL, TSL, ENG, RPU) would be expected to be of higher quality in order to bring ATV programming to the studio from a remote location. These circuits must provide near-studio quality performance.

STL and other auxiliary spectrum circuits are critical to broadcasters. The word auxiliary is somewhat of a misnomer. There are many stations which could not exist without the STL (studio-to-transmitter link), ICR (intercity relay), TSL (transmitter-to-studio link), SEL (satellite entrance link), RPU (remote pickup) and ENG (electronic news gathering) circuits that are in daily, if not constant, use. The need for STL and other auxiliary circuits will continue to

exist and likely will expand when the Advanced Television Service begins.

The ATV video and audio signal will be encoded for broadcast either at the studio or at the transmitter site. This is a major factor affecting auxiliary spectrum needs. If the ATV signal is encoded for broadcast at the studio, the baseband bandwidth requirements for the STL will be no more than 6 MHz. Current NTSC baseband bandwidth is 4.2 MHz for video and up to 7.5 MHz (or higher) when audio and control subcarriers are added. The nature of the encoded signal (analog, multi-carrier or digital) will determine whether the protection ratios for a given STL will need to be changed from those used in current practice.

If the ATV encoder is located at the transmitter, then high definition baseband video (in some form) and related audio signals must be transmitted over the STL. This approach is likely to require much more spectrum than for NTSC.

A third possibility exists. The high definition video and audio might be digitally encoded at the studio for transmission over the STL and re-encoded into the ATV format at the transmitter for broadcast. The effects of multiple encoding and decoding, however, must be understood prior to implementing this scheme.

Enhanced NTSC signals will likely require higher performance from the existing STL than for NTSC. Enhanced NTSC signals contain more information than a standard NTSC signal. In order to transmit the extra information, more

spectrum may be needed on the STL and other microwave circuits than is currently needed for NTSC and audio subcarriers. Converting the baseband high definition video to enhanced NTSC at the studio could have a significant impact on the design of the microwave circuit.

NTSC to ATV upconversion and ATV to NTSC downconversion will take place either at the studio or at the transmitter. During the NTSC to ATV transition period, and for some time thereafter, it will be necessary to translate from one format to another. The current stock of NTSC programs and NTSC sources will have to be converted to the ATV format at some point in the chain for transmission over the ATV transmitter. Conversely, ATV programming will have to be converted to NTSC for transmission over the existing NTSC transmitter. The complexity of conversion and the kind of transmission circuit available between the converter and transmitter will determine where the converters should be located.

A new STL will be needed if the ATV transmitter is not co-sited with the existing NTSC transmitter. There will be some instances in which the ATV transmission facility cannot be collocated with the existing NTSC facility due to lack of tower space or other factors. A new STL, either microwave or fiber, will be needed to interconnect the new facility with the studio. If via fiber, no spectrum will be required. If by microwave, a new path will be needed. The collocation problem is more likely to be encountered in spectrum congested areas where additional channels in existing auxiliary service

bands are not available than in areas where there is less congestion. New spectrum coordination techniques or new spectrum will be needed to satisfy new STL requirements.

Digital compression techniques may have a major impact on the design of broadcast auxiliary circuits. The benefits of digital encoding and compression techniques of video signals are not yet fully understood. The bandwidth requirements and protection ratios may change substantially. Digital modulation is less susceptible to interference than analog modulation. Furthermore, even the use of high performance multi-phase digital modulation permits the reconstruction of the original signal.

C. Questionnaire

A letter was recently sent to the ATV proponents seeking information that will help to identify ATV non-broadcast spectrum requirements from the systems point of view. Decisions regarding individual subsystems need to be made in light of all other aspects, such that the complete system preserves the signal integrity in an efficient, cost-effective and pragmatic manner. Microwave communications are just one of the many subsystems that need to be considered.

A complete systems approach requires the understanding of all elements in that system. Several questions were sent to the proponents and need to be addressed to achieve that understanding. These questions are described briefly below. The results of this questionnaire will be incorporated into the future work of Specialist Group 3.

1. Can the transmission/compression format the proponent is proposing as a broadcast standard be transmitted over a point-to-point microwave channel, or must it be modified? If modified, in what way?

Some of these channels, known as "Contribution Circuits," are intended to handle signals that will be mixed into program material downstream, such as those from another studio. The performance requirements are generally the highest of any microwave channels. While the definition of these Circuits will vary among situations, in every case the intent would be to allow the mixing of video signals from outside a particular studio with signals within that plant. Examples would include the option of performing digital video effects between these two sources.

Other channels carry signals not intended to be added to other program sources, but rather feed distribution networks such as terrestrial transmitters. One principal example would be a broadcast station's studio-to-transmitter link (STL). These channels are known as "Distribution Circuits."

There are many situations where the intended use of the signal may change, thus changing the definition of the Circuit. NTSC allows this change without a change in signal format since the NTSC signal format is employed in both types of circuits. The possibility now exists that multiple formats will be required to avoid the concatenation of conversion processes and thus preserve the signal integrity. Preservation of bandwidth is also of utmost concern.

2. Can the transmission and compression format the proponent is proposing as a broadcast standard serve for both Contribution Circuits and Distribution Circuits? If it cannot serve for Contribution Circuits, what format should be proposed for Contribution Circuits? Would more than one signal path be needed in parallel to provide a complete Circuit? (i.e., component signals, such as R/G/B or $Y/P_r/P_b$, or split composite signals are proposed to be sent).

   (See Appendix A for Microwave Technical Specifications)

3. What bandwidth(s) would be required for the proponents' Contribution Circuits and Distribution Circuits over microwave? Would the modulation of each Circuit type used be FM or another form?

   (See Appendix B for the Electrical Performance of NTSC Microwave Links)

4. The proponents were also asked to provide a list of performance requirements that might be analogous to the ANSI/TIA/EIA-250-C requirements, modified appropriately for their signal format. If this is different for Contribution and Distribution Circuits, both sets of requirements would have to be provided.

D. A Study of Auxiliary STL Spectrum Space

In order to explore the impact of ATS on broadcast support spectrum in markets below the top 30, a study was done of frequency coordination in the state of North Carolina assessing the availability of 7-GHz broadcast auxiliary microwave spectrum space. The intent of this study was to determine the possibility of providing a second STL channel (6 MHz of baseband) within the current 7-GHz Broadcast Auxiliary Band for ATV STL's. It was concluded, as described in more detail below, that an additional STL channel to carry the ATV signal could probably be made available to each North Carolina broadcaster from existing spectrum allocations, but the

installation of high performance microwave antennas on affected co-channel links is likely to be required.

The four largest television markets (DMA) in North Carolina are Charlotte #31, Raleigh/Durham #33, Greensboro/ Winston-Salem #49, and Asheville/Greenville/Spartanburg #35. In addition, there are two other smaller markets: Wilmington #145, and Greenville/Washington/New Bern #104.

Most television stations in North Carolina operate at 7 GHz. STL/ICR's typically use standard performance 6-foot microwave antennas similar to Andrew P6-65 (FCC Category B), or standard 8-foot antennas similar to Andrew P8-65. Only one broadcaster in North Carolina is using high performance antennas similar to Andrew HP8-65E. This type of antenna exhibits greatly improved side-lobe rejection compared to standard parabolic antennas.

Preliminary findings have indicated that in most areas of North Carolina, it would be possible to assign a second STL channel from existing allocations for ATV. However, this assignment would almost always require a change to antennas with narrower beam widths and diminished side lobes, and coordination of antenna polarization. In some cases additional filtering may be required, such as 20-MHz IF filters and 25-MHz RF filters.

The critical limiting factors are the angles and distances of each microwave installation relative to those of other users. It is difficult to coordinate additional microwave channels to broadcasters operating in similar

locations, where relative path angles between systems are small.

The NAB Television Auxiliary Frequency Usage Survey revealed high levels of congestion in the 7 GHz microwave band, but did not specifically ask if additional capacity would be possible by re-engineering microwave paths. Other states similar to North Carolina in population density and area would find, in many cases, that BAS spectrum is available for extra STL channels if microwave paths were carefully engineered.

Additional STL and other auxiliary spectrum will be needed in many areas of the country. It is certain that the top 30 markets will need additional microwave spectrum for ATV STL's. The amount of additional spectrum required is dependent upon the degree of efficient use of the spectrum and the utilization of alternate technologies for interconnection such as fiber.

E. Possible New Spectrum For ATV Broadcast-Support

The rapid strides being made with respect to new technology such as video compression, fiber optics, and with respect to improvements in microwave equipment and techniques cannot be disputed. But it has become obvious that some additional spectrum will be needed, primarily in major markets -- at least for the short terms -- to meet the requirements for ATV broadcast-support spectrum. The purpose of this section is to review the spectrum considerations involved and to suggest possible segments of the microwave spectrum that

might be reallocated to meet these needs. (Although television broadcast operations employ much aural service equipment, such as remote pickup transmitters for program, coordination, and remote control, cuing devices, and wireless microphones, spectrum needs for these applications are not nearly as critical as the needs for additional video transmission spectrum.)

1. Background

In the three prior Interim Reports of SG-3, the use of broadcast-support facilities used in television operations has been described, possible long-term solutions to fulfill additional requirements have been suggested, and a survey taken by NAB of current broadcast microwave usage in the top markets has been described. Spectrum requirements have been considered for compatible, augmentation, and simulcast systems. The current thrust is on simulcast systems, which will have the greatest impact on the need for additional support spectrum. Analog, or hybrid analog-digital systems have been considered, while, at the present time, some changes to additional digital proposals are being discussed. This development could also affect the requirements for support spectrum. Also, although it is not clear at this time, it appears that there will be at least some degree of duplicate NTSC and ATV transmissions over support facilities.

Based on the NAB survey of the top markets, in many instances currently allocated microwave channels are used to the fullest extent with the likelihood of additional capacity

within the current structure being almost nil. Los Angeles is a good example. There are 15 TV transmitters atop Mt. Wilson, each with at least two microwave circuits between the studio and this site, one STL and one TSL. Most of the stations are heavily involved in ENG operations, involving the use of one or more microwave channels on the ENG vehicle and typically several microwave channels from repeater points to Mt. Wilson. (Because of the mountainous terrain and the wide area served by the Los Angeles stations, several repeater sites are required.) There is also extensive use of Cable Television Relay Service (CARS) stations in the Los Angeles area that share the same frequencies used by the broadcasters.

The use of the existing frequencies by all the parties involved is made possible only by the close coordination process employed by the local frequency coordinating committee. The possibility of accommodating additional channels is virtually nonexistent.

2. Possible Solutions for Lessening Spectrum Needs

It must be recognized that the installed base of existing equipment and the economics of acquiring or leasing new facilities will be a factor with respect to the timetable for full implementation of ATV. However, SG-3 has identified the following possible items for easing spectrum requirements:

- fiber optics to replace or augment fixed microwave circuits (See Appendix C for a discussion on the potential of fiber optics);
- video compression techniques to reduce per TV signal bandwidth;

— improvements in equipment and operating techniques, including FM deviation optimization, larger and shrouded antennas, and lower noise figures for pre-amps and receivers;

— better utilization of the currently allocated but lightly used 18, 23, 30 and 40 GHz bands;

— possibility of using a single STL carrying ATV which could be "ownconverted[2]" to NTSC at the dual-transmitter site.

- for satellite service, the possible eventual use of the 20/30 GHz bands.

3. Additional Spectrum

a. Relevance of the Work of SG-4

Specialist Group 4 was charged with examining the spectrum above 1 GHz to identify blocks of spectrum that might possibly be used to establish an ATV service, in the event that an ATV service could not be accommodated in the VHF/UHF television bands. Fortunately, it appears now that ATV can be so accommodated. If not needed for the broadcast service, the frequencies identified between 1 - 13 GHz might be considered for support facilities. (The results of the ATV propagation and channel characteristics tests are not needed for the application suggested herein, since this band is known to be eminently suited for point-to-point microwave links.)

The FCC, in its original NOI, requested information on the 2.5 - 2.69 GHz and 12.2 - 12.7 GHz bands, which roughly

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[2]With respect to conversion, it has also been suggested that, if continuous service on the ATV transmitter becomes a requirement, it may be possible to "up-convert" NTSC programming to pseudo-ATV, roughly analogous to the use of synthesized stereo audio for TV.

bracket the major band of interest, 1 - 13 GHz. The results of the work of SG-4 have been described in its Interim Reports, but are briefly summarized herein as possible candidates for additional broadcast-support spectrum.

b. 2.5 - 2.69 GHz Band

This band is allocated to the ITFS/OFS/MDS/MMDS services and is used extensively, primarily in the major markets. Recent FCC actions, designed to foster MMDS development, made it even more dubious that this band could provide any help.

c. 4.4 - 4.99 GHz Band

This band is allocated domestically to the government Fixed and Mobile Services, but is currently set aside for high-powered military tropo-scatter systems. It is our understanding that these systems are mainly in warehouses awaiting deployment as needed. The principal use in the U.S. during peacetime is presumably for training exercises in limited geographic areas remote from urban centers. This band would appear worthy of consideration for new broadcast-support spectrum.

d. 7.5 - 7.9 GHz Band

This band is allocated domestically to the government Fixed Service only. It is used by two or possibly three agencies for non-military microwave relay systems of intermediate length. The intensity of use is not known. If government use is not heavy, it may be feasible to devise a plan

whereby the band could be shared with the Auxiliary Broadcast Service.

e. 12.2 - 12.7 GHz Band

This is the Broadcast Satellite Service (BSS) downlink band. Although the service was authorized over eight years ago, there are currently no operating systems. However, there are many authorizations extant with more about to be made.

One of the major broadcast-support uses is for satellite distribution and contribution circuits in the Fixed Satellite Service (FSS) band. In addition to the heavy use by broadcasters, there are over 200 other video services distributed by satellite. There is some indication that video compression techniques will first be employed in the FSS, which might lead to the accommodation of all satellite requirements, even in the short-term.

In its Second Interim Report SG-3 states: "Should the DBS band with its 9 degree orbital spacing continue to be under-utilized in the future, conceivably some of this spectrum might be considered for additional FSS channels."

f. Other Spectrum Possibilities

It is noted that the FCC has suggested several frequencies for possible use for a Digital Audio Broadcast (DAB) service, including 1493 - 1525 MHz and 2390 - 2450 MHz. If for one reason or another these bands are not selected for DAB, consideration should be given to providing additional broadcast-support channels in some parts of this spectrum.

It is also noted that the NAB has instituted a study of possible spectrum for DAB. Here again, any bands identified for possible use, and not selected for DAB, might be considered for broadcast-support channels.

F. Conclusions

There are two critical issues which will have a major impact on the broadcast auxiliary spectrum requirements for advanced television. The interpretation of simulcast, if defined to permit some operation independent from the NTSC channel will require more auxiliary circuits. The choice of a particular ATV system could also have a substantial effect on broadcast auxiliary spectrum requirements.

Future work of Specialist Group 3 will focus on the results of the questionnaire recently sent to proponents seeking information that will give the system specific non-broadcast spectrum requirements. The non-top-30 market auxiliary STL spectrum study (North Carolina) that was conducted during this reporting period demonstrated that even in a medium density population area, additional STL and other auxiliary spectrum will be needed. The amount of additional spectrum required will be related to the degree of efficient use of existing spectrum and potential utilization of alternative technologies.

Based on current information, the bands 4.40 - 4.99 GHz and 7.75 - 7.90 GHz represent the best possibilities for providing additional channels, at least for the short term for ATV broadcast-support spectrum. It is recommended that the

FCC institute a dialogue with the NTIA to consider these proposals. (The SG is aware of the pending legislation that would transfer 200 MHz of government spectrum to the private sector. Hopefully the needs of the new ATV service would be considered in any such re-allocation.)

SG-3 will also follow the developments in the search for DAB spectrum for other possibilities for added spectrum for new ATV support facilities.

IV. ACCOMMODATING ATV IN THE SPECTRUM ABOVE 1 GHZ (SPECIALIST GROUP 4)

In the Third Interim Report, Specialist Group 4 (PS/SG-4) reviewed its charge, described the work done to date at that time, and indicated that PS/SG-4 would defer any further activities pending a review of the propagation test results from the Advanced Television Test Center (ATTC). In view of the preliminary but promising results with respect to the possibility of accommodating ATV within the existing VHF/UHF television broadcast bands, and the higher priority ATTC tasks of planning for the system laboratory tests, the preparation of the raw propagation test results into a format suitable for analysis remains to be done. Since the question of terrestrial broadcasting in the spectrum above 1 GHz might still have some relevance, any further action by PS/SG-4 will continue to await the availability of the propagation data for analysis. Specialist Group 4 also took note of the fact that tests have been conducted on terrestrial broadcasting in the 12 GHz band in Mexico City. Since the test results may be of

interest, they will be submitted to Specialist Group 4 for review and discussion.

V. SPECTRUM ANALYSIS AND TABOOS (SPECIALIST GROUPS 6, 7 AND 9)

The work of Specialist Groups 6/7 (SG-6/7) of PS/WP-3 has not required the convening of meetings during the period covered by this Fourth Interim Report. However, progress has been made toward the ultimate objectives assigned to SG-6/7 dealing with spectrum availability for ATV systems, including the impact of "taboos" if applicable to ATV. That progress is reported in the balance of this section.

PS/WP-3 and, more specifically, SG-6 will be required to provide the accommodation statistics and allotment tables for each ATV system when data are available from both objective and subjective laboratory tests. (Assignment tables will be required also, but decisions relative to assignment principles are not within the scope of PS/WP-3.) Most importantly, the laboratories will have to supply data concerning desired and undesired power combinations for interference from ATV to NTSC, NTSC to ATV, and ATV to ATV. (With suitable definitions of ATV and NTSC power, these combinations can be expressed as ratios.)

The first of the three interference ratios specified (ATV to NTSC) will permit a determination of ATV power/height levels and separations necessary to avoid unacceptable interference to NTSC stations. Starting at separations which studies show to be necessary for full accommodation of

existing television licensees, and employing the ATV power/ height level determined to be the maximum permissible to avoid unacceptable interference to NTSC, the latter two interference ratios will be used to predict the extent of the ATV service area. Although in some directions the limit of the ATV service area may be determined by the signal-to-noise ratio, interference is expected to be the primary determinant of the extent of service. If calculations demonstrate that ATV stations spaced to permit full, or nearly full, accommodation have an unacceptably small service area, the relationship between ATV service area and accommodation will be determined.

Accomplishment of the foregoing objectives requires a computer program permitting consideration of the entire United States database of authorized stations and a sufficient part of the Canadian and Mexican television allotments to permit the development of a table for ATV simulcast allotments. That program should have the capability of applying different allotment algorithms and taking into account any taboos that need to be retained for the ATV service. Additionally, a computer program permitting the rapid preparation of graphical representations of service areas as affected by interference for a variety of spacing and power/height combinations is desirable, although manual determinations of service areas are feasible. The Zenith Corporation has developed a computer program running on a personal computer (PC) for the plotting of the interference-free service areas needed. However, additional work on that program is needed to make it maximally

useful for the task at hand. Arrangements have not yet been completed to expand the program as necessary.

Fortunately, the Broadcasters' Caucus of the Advanced Television Systems Committee has taken on the task of programming and running a computer to solve the allotment problem. A program has been written, and preliminary data are becoming available. Emphasis must be given to the fact that allotment tables for the proposed ATV simulcast stations cannot be produced until the laboratory data referred to above are available. However, as a first task, studies have been undertaken to determine the impact of taboos on total accommodation statistics. The results of those studies are reported below.

The studies examined the impact of keeping and/or relaxing some or all of the existing NTSC taboos on the availability of ATV spectrum. Specifically, they examined the impact of protecting a single NTSC taboo, such as the first, second, third, fourth, seventh, eighth, fourteenth or fifteenth channel removed from the assigned NTSC channel (i.e., above and below the assigned channel), or multiple taboos (intermodulation, cross modulation, IF, 1/2 IF Beat, etc.) on the overall availability of ATV spectrum. Also included in the analysis is the effect of reducing taboo mileage separations as well as allowing collocation, or near collocation of the taboo channel.

Three different scenarios were used to assess the availability of spectrum for ATV. The first scenario applied

the taboo restrictions to all ATV and NTSC assignments. The second scenario applied the taboo restrictions only to existing NTSC assignments. The third scenario also applied the taboo restrictions to existing NTSC assignments; however, it allowed collocation or near collocation of the taboo channel.

Document PS/WP-3-165 contains detailed findings and observations of these studies. (A revised version of this document is attached as Appendix F.) However, they can be consolidated into four preliminary findings:

1) Regardless of which scenario was examined, the adjacent channel taboo was determined to achieve the worst accommodation statistics for ATV, while the IM-related taboos exhibited the best statistics.

2) The NTSC/Collocated Scenario was determined to achieve the best accommodation statistics.

3) Except for the picture image taboo, the effect of increasing or reducing taboo separation distance has little or no impact on the ATV accommodation statistics.

4) Allowing exact collocation of the taboo channel slightly/moderately improves the accommodation statistics of ATV. Near collocation of the taboo channel adds little, if any, improvements to the accommodation statistics.

With regard to the work of Specialist Group 9 dealing with cross-border issues, no further meetings have been held during the reporting period with Canada relative to allotments for an Advanced Television System. Reorganization of the

Canadian group has not yet been completed so they have not been in a position to continue the joint work previously begun.

VI. PLANNING FACTORS DEVELOPMENT (SPECIALIST GROUP 10)

A. Introduction

Planning factors will form the structure for determining the basic service area(s) for the new ATV service. This section sets forth the work of PS/WP-3 on a) Planning Factors Development, b) Definition of Spectrum Criteria, and c) Criteria Evaluation.

B. Factors Development

The factors described below determine the noise-limited service area in the absence of interference from other stations. This will be based on ERP, antenna height, and typical receiving systems for specified availability statistics. The existing rules for NTSC define two grades of service, Grade A, defined by an inner contour, and Grade B, defined by an outer contour. It has been suggested that if two contours are necessary for the ATV service, these should be ATV Service Contour I (inner), and ATV Service Contour II (Outer). However, as the chosen ATV system will more likely than not be digital, it has been suggested that, since for such systems the signal drop-off will be rapid at a certain single distance, only one service area should be defined. In this is case, it would be an interference limited service area that would approximate that of the Grade B NTSC service area.